Small Business Innovation Research/Small Business Tech Transfer

Tailoring the Solar Spectrum for Enhanced Crop Yield for Space Missions, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

UbiQD, Inc, is partnered with the University of Arizona, Controlled Environment Agriculture Center to enhance the lighting component of the Mars-Lunar Greenhouse prototype to improve the food production for the system. Ultimately, the goals is for UbiQD to install a down-conversion film composed of Quantum Dots (QDs) into the solar collecting/fiber optic system to not only provide higher quality PAR spectrum than currently using, but by converting the high concentration of UV photons to visible photons, UbiQD would be able to dramatically increase the intensity of the PAR spectrum provided to the plants.

In this project, we will prove the feasibility of using a spectrum-modifying film to improve the quality of light given to a plant, which will lead to more efficient growth and better crop yields. By demonstrating the quality of the light spectrum also plays an important role in growing plants efficiently, UbiQD and the University of Arizona will feel confident in moving on to the next steps of integrating the QD technology into a solar collection device for the Lunar/Mars Greenhouse, and moving closer to designing a plant growth chamber that could be deployed on longer manned space missions.

To demonstrate the feasibility that changing the quality of incident light by using a down-converting film will improve lettuce crop yield, two different Ag-Films will be fabricated and used to modify the light spectrum from a Xenon (Xe) lamp system (which best mimics solar irradiation). Then a crop study will be conducted on lettuce crops grown in an indoor hydroponic grow system, where three different sets of lettuce will be grown under the spectrally-modified films.

We will also model and estimate the improvement in crop production compared to previous crop production values measured under high pressure sodium lighting in the Mars-Lunar Greenhouse prototype by both utilizing the Ag-film's ability to convert UV light to PAR as well as improving the overall quality of PAR light.

Anticipated Benefits

- Spectral modification for enhanced plant production for long space missions and planetary exploration (this project)

- Remote phosphor for customized plant growth spectra using blue LEDs as a light source

- Remote phosphor for customized spectra for solid state lighting in space vehicles, space stations and living quarters

- Renewable electricity production from transparent surfaces, such as windows

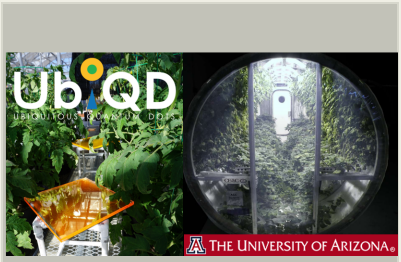

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Table of Contents

Tailoring the Solar Spectrum for Enhanced Crop Yield for Space Missions, Phase I

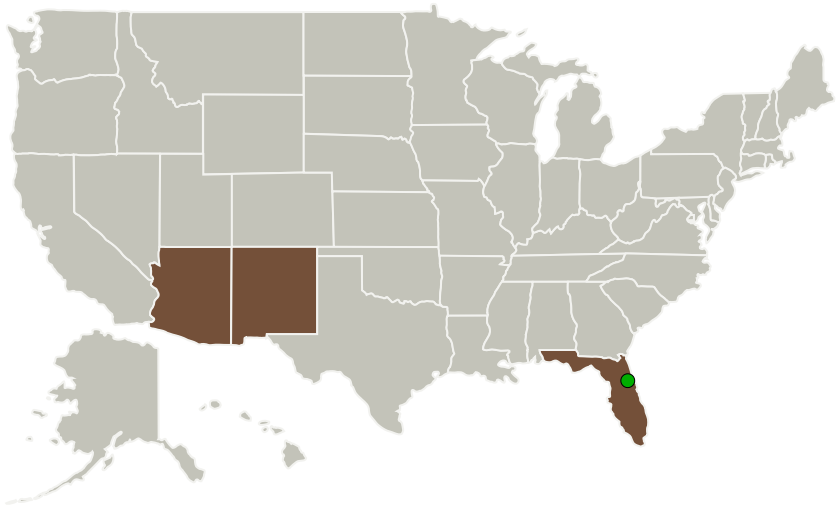
Completed Technology Project (2018 - 2019)

- Fixed position solar spectrum modifying Ag Films for enhanced crop production in greenhouses

- Deployable solar spectrum modifying Ag Films for inducing early flowering or fruiting of the plant

- Renewable electricity generation from the transparent surfaces of a greenhouse structure, including the walls and roof

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
UbiQD	Lead Organization	Industry	Los Alamos, New Mexico
Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
University of Arizona	Supporting Organization	Academia Hispanic Serving Institutions (HSI)	Tucson, Arizona

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

UbiQD

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

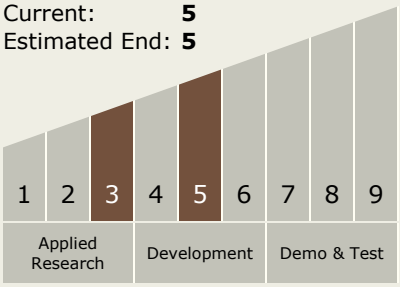
Carlos Torrez

Principal Investigator:

Matthew Bergren

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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Completed Technology Project (2018 - 2019)

Primary U.S. Work Locations	
Arizona	Florida
New Mexico	

Project Transitions

July 2018: Project Start

August 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137914)*

Images

Final Summary Chart Image
Tailoring the Solar Spectrum for Enhanced Crop Yield for Space Missions, Phase I
(https://techport.nasa.gov/image/131455)

Project Image
Tailoring the Solar Spectrum for Enhanced Crop Yield for Space Missions, Phase I
(https://techport.nasa.gov/image/133104)

Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.1 In-Situ Resource Utilization
    - TX07.1.3 Resource Processing for Production of Mission Consumables

Target Destinations

Earth, The Moon, Mars